

memo
from ...



STAT

9 Sept '66

Dick -

This is a copy of our
request sent out this date.

Appreciate your follow up to
expedite it as much as
possible.

Thanks,
Fed

STAT

March 14, 1968

STAT

Dear [redacted]

STAT

The following report divided into section I and II describes in rough draft form how the problem of color materials and equipment has been organized and the information that has been collected to date.

In reading over the report, be particularly critical in the areas of:

1. The information to be included under photographic materials as shown in the outline and example.
2. The types of photographic materials to be included under still, aerial, and motion picture as listed in the outline.
3. The types of photographic equipment as listed.
4. The information to be included under photographic equipment as shown in the outline and example.
5. The organization of material as shown in Figure 1.

Feel free to delete or write comments on the information content of the report since it is still only a rough draft. After you have given the report your careful consideration, please provide us with some form of feedback.

Sincerely,

STAT

KRE/jm

Encl

Section I

In addition to the availability of negative and positive materials the end photographic product, usually a positive image of the original scene, can result in either a paper print to be viewed by reflected light or a transparency to be viewed by projection or transmitted light.

Material

The following outline lists the factors of a color photographic material which could be considered important in a material's application.

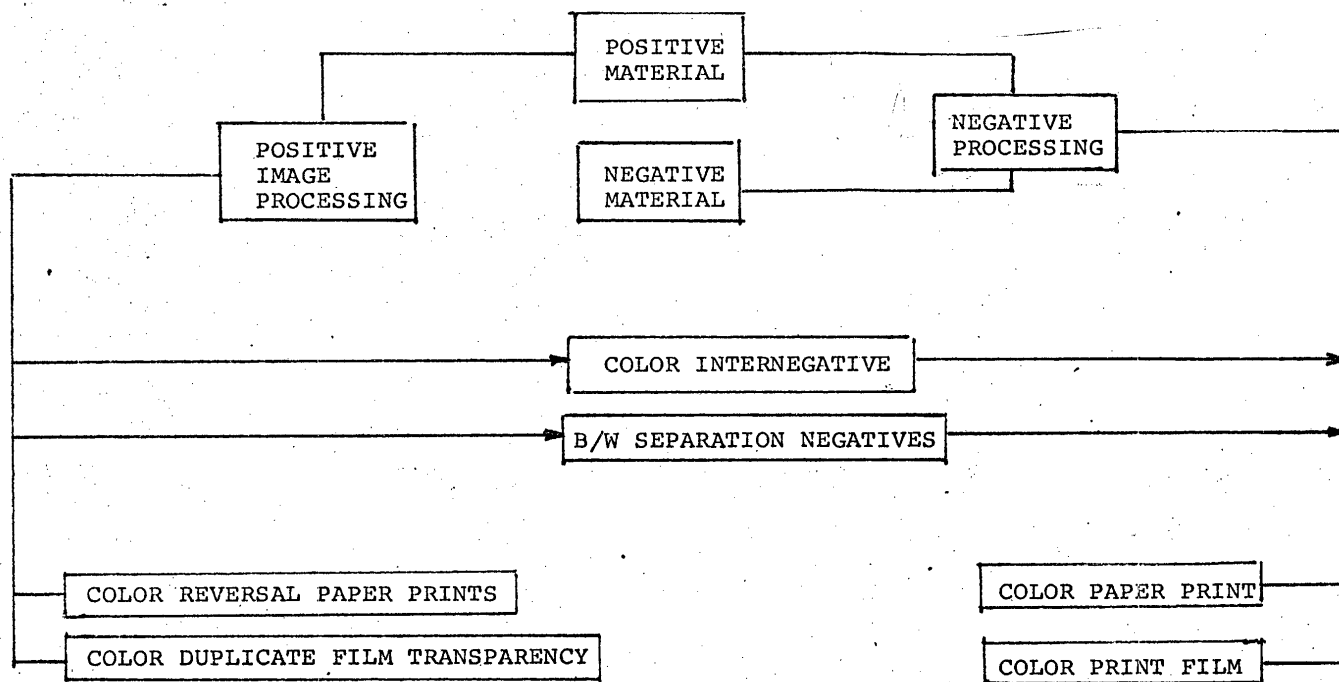


Figure 1.

I. Photographic Material

A. Name of Material

B. Description and Use

C. Photographic Characteristics

1. D log E curve

2. Speed

3. Gamma

4. *Color Quality*

5-4. Spectral Sensitivity

6-8. Dye, Absorption Curves

7-8. Reciprocity Response

8. Suggested Exposure and Filtration

a. Daylight

b. Electronic Flash

c. Clear Flashlamps

d. Floodlamps - Fluorescent

9, 8, Resolution

D. Physical Characteristics

1. Layer Orientation

2. Processing Shrinkage

3. Humidity Coefficient

4. Water Elongation

5. Folding Endurance

6. Stiffness

7. Modulus of Elasticity

8. Tensile Strength

9. Yield Strength

10. Elongation at Break Point

- 11. Total Thickness
- 12. Base Type
- E. Processing
 - 1. Chemicals
 - a. Mixing
 - b. Storage
 - c. Replenishment
 - 2. Procedure
 - a. Temperature
 - b. Time
 - c. Number of Steps
 - d. Drying
- F. Storage
- G. Sizes

Photographic laboratory equipment becomes a necessary consideration when processing, printing, and handling photographic material in sheets or long rolls. Not only are the equipment requirements different for the size and type of material but the access time of the final product will depend a great deal on the types of laboratory equipment used.

The following types of photographic laboratory equipment for color are considered to be the most important for efficient laboratory operation.

- 1. Print and Film Washers and Dryers.
- 2. Temperature Control Units ✓
- 3. Printing Easels ✓
- 4. Viewers and Splicers ✓

5. Sensitometers and Densitometers
6. Timers
7. Sinks, Tanks, and Trays
8. Contact and Projection Printers
9. Continuous Processors.

The above list contains a large variety of equipment. In order to present all of it in a uniform manner and provide pertinent information the equipment will be presented in the following form.

II. Photographic Equipment

- A. Picture of Apparatus
- B. Brief Description of Use
- C. Manufacturer
- D. Operating Requirements
 1. Electrical
 2. Water
 3. Gas
- E. Operation
 1. Speed
 2. Sensitized Material Capability
 - a. Size
 - b. Paper or Film
 3. Capacity
 - a. Chemical
 - b. Volume
 - c. Output
 4. *Repeatability*
 5. *Uniformity*

- F. Special Features
- G. Disadvantages
- H. Additional Equipment Required
- I. Physical Characteristics
 - 1. Weight
 - 2. Size
 - 3. Environmental Requirements
- J. Price

From the previous discussion concerning photographic materials, processes, and equipment it should be evident that these three factors require consideration in the handling of photographic materials. It would indeed be a great help to an organization if all the latest information was catalogued on photographic materials, processes, and equipment. With this information at hand an organization would know how effectively they could handle a photographic problem. This collection of information could take the form of the following:

I. Processes

A. Negative/Positive

1. Camera Films

- a. Professional Still
- b. Aerial
- c. Movie

2. Reproduction Materials

- a. Reflection Print
- b. Transparency

B. Positive Materials

1. Camera Films

- a. Professional Still
- b. Aerial
- c. Movie

2. Reproduction Materials

- a. Reflection Print
- b. Transparency

II. Equipment

- A. Washers
- B. Dryers
- C. Easels
- D. Viewer/Splicers
- E. Sensitometers
- F. Densitometers
- G. Printers
 - 1. Contact
 - 2. Projection
 - 3. Continuous
- H. Processors
 - 1. Tank
 - 2. Reel
 - 3. Continuous

The organization of the photographic materials corresponds to the flow diagram of Figure 1 which traces a color photographic material through its processing and reproduction stages. In this form the information needed for a photographic problem is organized according to the process making it operationally oriented.

The information required for the photographic materials and equipment will depend largely on its intended use. The camera-man is primarily interested in obtaining correct exposure and color balance of the original scene. On the other hand a photographic processing facility is primarily concerned with handling the material after the exposures have been made. The two areas of interest can never be completely isolated from one another but the area of emphasis will change depending on the purpose. Obviously manufacturer's data represents the largest source of data on photographic materials and processes. Unfortunately in most cases evaluation standards have not been determined for color photographic materials. Due to this, it is difficult to rank one material against another without actually performing your own evaluation. In most cases manufacturer's color data is consistent for film speed, description of processing procedure, and resolution capabilities, if supplied.

Surprisingly only qualitative values are placed on the color aspects of materials and little if anything is said in relation to the level of quality obtained with successive reproduction. The following example of Anscochrome 200 represents a more complete description of a color photographic material than most.

ANSCOCHROME D/200 35MM COLOR FILM

DESCRIPTION

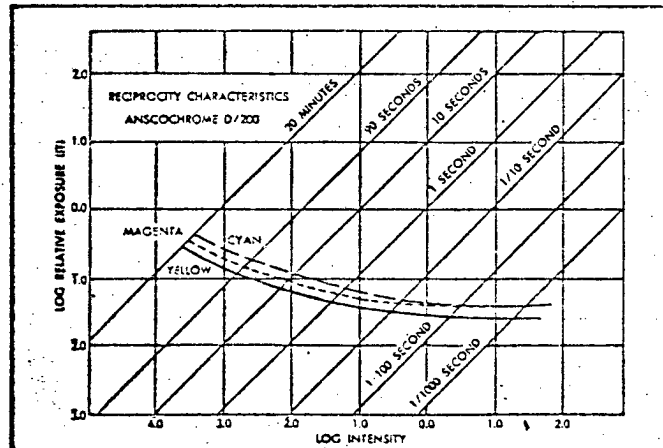
Anscochrome D/200 is an extremely high speed reversal film designed to produce color transparencies when exposed in daylight, or with blue flashbulbs or electronic flash. It is recommended where maximum film speed is required for low light-level situations. Anscochrome D/200 is available in 20 exposure 35mm magazines.

SENSITOMETRIC CHARACTERISTICS

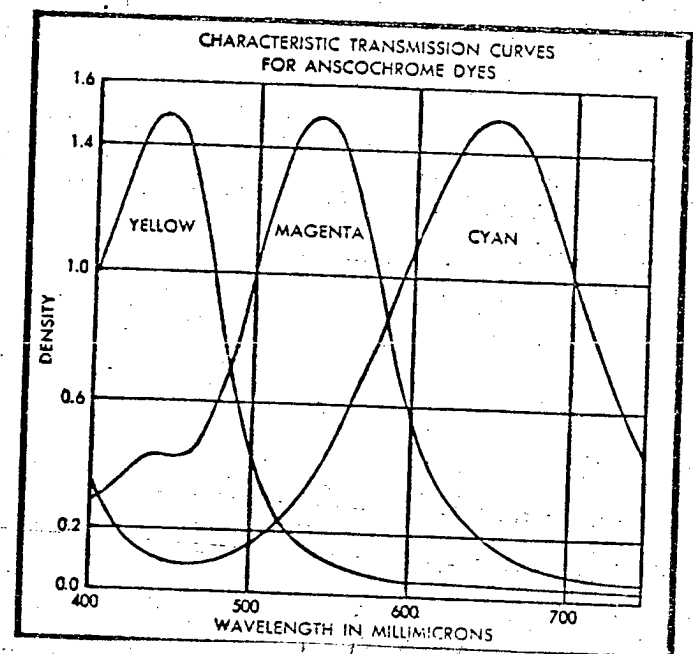
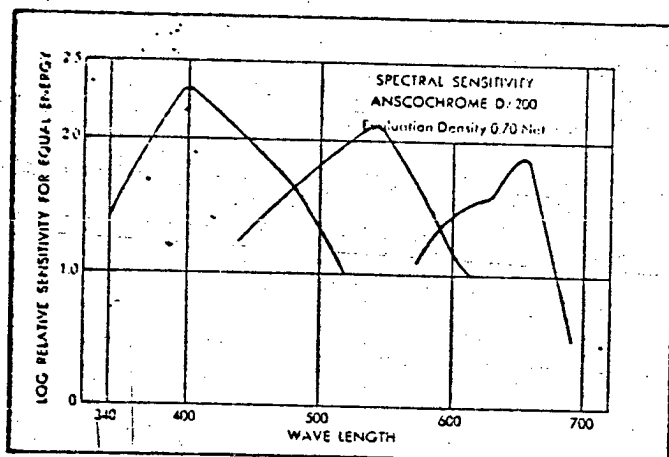
1. SPEED - Anscochrome D/200 has a film speed of $200/6^0$ when exposed with the proper light source. This results in fast shutter speeds or small apertures, or both can be used for greater depth of field, stop-action photography, and low light-level photography.

2. COLOR REPRODUCTION - Anscochrome D/200 records colors with life-like faithfulness. Brilliant true reds, neutral grays and whites, and realistic, satisfying color rendition through the whole spectrum are characteristic of Anscochrome D/200. New emulsion formulations give Anscochrome D/200 clear, sparkling highlights never before possible.

3. RECIPROCITY RESPONSE - Anscochrome D/200 is nearly free from reciprocity law failure. Tests show no appreciable change in color balance in exposures as short as 1/5000 second or as long as 4 seconds. The curves below show the departure from the reciprocity law for each of the layers of Anscochrome D/200. Reciprocity law failure is determined for a net density of 1.0 with an exposure having a color temperature of 6000K.

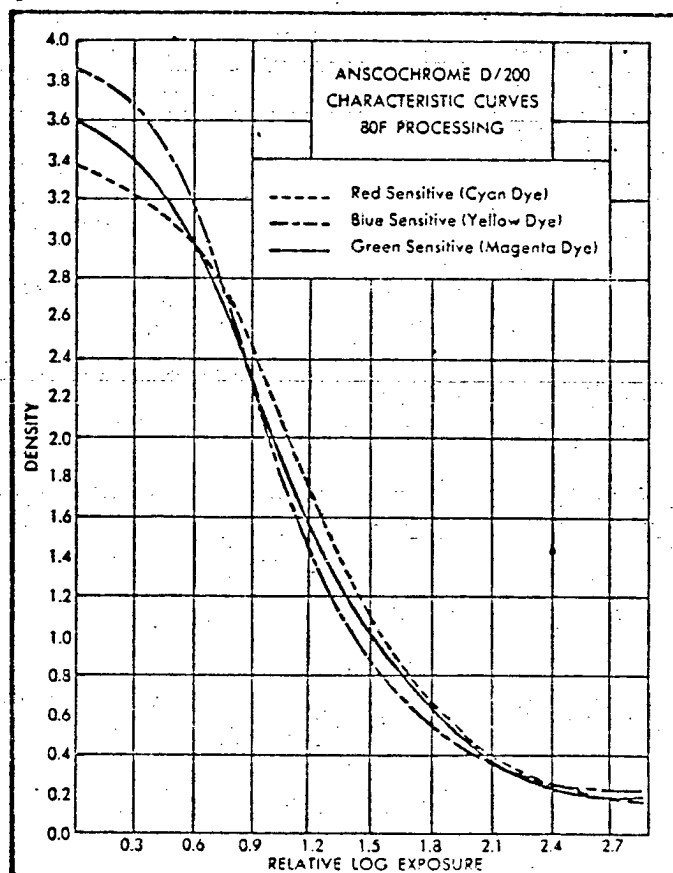


4. SPECTRAL SENSITIVITY - The spectral sensitivity of Anscochrome D/200 exposed to light of equal energy at all wavelengths to produce a net density of 0.70, is shown below. Transmission curves of Anscochrome dyes are also shown.



CHARACTERISTIC CURVES

Characteristic curves for Anscochrome D/200 film are given below.



EXPOSURE

FILTER CHART - ANSCOCHROME D/200 FILM

<i>Illuminant</i>	<i>Color Temperature</i>	<i>Recommended Filter*</i>	<i>Film Speed (With Filter) or Other Exposure Recommendation</i>
Daylight or Blue Flashlamp	5900-6000K	Film is balanced for light of this quality. No filter required.	200/6°
Electronic Flash	6000-7000K	Flashtubes emitting light of a color temperature close to 7000K require the use of an 81A or equivalent filter over the lens	Use the guide numbers given in the table below. If an 81A filter is used, increase exposure by $\frac{1}{3}$ stop.
Clear Flashlamp	3800-4000K	This light source is not recommended for use with daylight type color films.	
Photoflood	3400K	80B or equivalent	100/5°
Studio Lamp	3200K	80B + 82A or equivalent	80/4.5°

Note: All filter recommendations are close approximations. For critical work, use this table as a guide for further tests. Always select the film which requires the least filtration for your lighting conditions.

DAYLIGHT EXPOSURE - ANSCOCHROME D/200

The following table for outdoor exposures is based on Average Subjects front lighted. Side lighted subjects require about 1/2 stop wider opening. Back lighted subjects require one full stop wider lens opening. Additional exposure compensations should be made for the following:

LIGHT SUBJECTS (Nearby people in marine, beach and snow scenes, distant scenery, etc.) about 2/3 stop smaller lens opening. Beach, marine, and snow landscapes - one stop smaller lens opening.

DARK SUBJECTS (people in dark clothing, dark foliage, flowers, animals, buildings, etc.) 2/3 to one stop wider lens opening.

Exposure Table: Set Shutter Speed at 1/125 or 1/100 Second		
Light Condition	Lens Settings	
Bright Beach, Boating and Snow Scenes	Set lens opening at f/32	Or use EV Number 17
Bright Sun, Clear Sky	Set lens opening at f/22	Or use EV Number 16
Hazy Sun, Filmy Clouds	Set lens opening at f/16	Or use EV Number 15
Light Overcast, No Sun	Set lens opening at f/11	Or use EV Number 14
Heavy Overcast, No Sun, or in Shade on Sunny Day	Set lens opening at f/8	Or use EV Number 13
Note: to reduce atmospheric haze in long shots, aerial, and over-water shots, use a 2A UV absorbing filter over the lens. Do not change lens settings.		

FLASHLAMP EXPOSURE GUIDE

The guide numbers given below are based on average subjects in light colored surroundings and the use of flash units with polished reflectors. Increase exposure 2/3 stop for matte reflectors. Increase exposure 1/2 stop for dark colored subjects; decrease exposure 1/2 stop for light colored subjects.

Follow the table below and select the guide number for the combination of flashbulb and shutter speed you will use. Divide the guide number by the distance in feet from the flashbulb to the subject to obtain the correct f/number.

FLASH GUIDE NUMBER TABLE			
Shutter Speed	Standard Shutters Set Synchronizer Lever At		Focal Plane Shutters Set Synchronizer Lever At "M"
	"X" or "1"	"M"	
	Guide Nos. for AG-1B or M-2B Flashbulbs	Guide Nos. for 5B, 25B or M-3B Flashbulbs	Guide Nos. for 6B or 26B Flashbulbs
1/25-1/30	140	250	—
1/50-1/60	112	238	189
1/100-1/125	—	189	125
1/200-1/250	—	133	88

ELECTRONIC FLASH EXPOSURES

Anscochrome D/200 is recommended for use with electronic flash illumination.

Some electronic flash units will require the use of an 81A filter over the lens to render transparencies of correct color balance. When an 81A filter is used, the exposure should be increased by 1/3 stop over that indicated in the table below. Consult flash unit instructions.

Set Shutter Speed at 1/250 or 1/500 second * and Synchronizer Lever at "X"									
Beam Candle Power Seconds									
450	900	1800	2675	4000	7000	16000	28500	64000	
Watt-Second Rating of Electronic Flash Unit									
25	50	100	150	225	400	900	1600	3600	
Guide Numbers									
75	105	150	185	220	300	450	600	900	

Divide guide numbers by flash-to-subject distance in feet to determine f/stop number.

*With focal plane shutters, a shutter speed not faster than 1/60 second must be used.

TUNGSTEN ILLUMINATION

With an 80B filter over the camera lens, Anscochrome D/200 may be exposed with photoflood illumination (3400K). Use a film speed of 100/5⁰ and follow the exposure table provided with the lamps.

With a combination of 80B and 82A filters over the lens, Anscochrome D/200 may be exposed with studio lamps (3200K). Use a film speed of 80/4.5⁰ and follow the exposure table provided with the lamps. For best results with tungsten illumination, use Anscochrome T/100 with a tungsten film speed of 100. Always attempt to select the film which requires the least filtration for existing lighting conditions.

FLUORESCENT ILLUMINATION

Fluorescent illumination is not ideally suited for color photography because of its discontinuous spectrum. However, at times it may be necessary or highly desirable to use this form of illumination for making color photographs. Because of variations in fluorescent tubes and the fact that Reciprocity may be a factor, it is not possible to give exact recommendations. However, the following filter information is offered as a starting point for tests to be made by the individual photographer.

Color Compensating Filters for Color Photography with Fluorescent Illumination	
<i>Lamp</i>	<i>Daylight Film</i>
Soft White.....	10B + 30C
Standard Cool White.....	10B + 10C
Daylight.....	10B
Standard Warm White.....	10B + 30C
DeLuxe Warm White.....	20B + 30C
White.....	20B + 20C

DARKROOM HANDLING - This film should be handled only in total darkness.

IMAGE CHARACTERISTICS

RESOLVING POWER - 90-100 cycles/mm

PHYSICAL CHARACTERISTICS

PER CENT SHRINKAGE

Processing .07 (Shrinkage due to normal processing and drying).

Total .08 (Shrinkage after processing, drying, and storage for 7 days, at 120F, 20% RH).

HUMIDITY COEFFICIENT - .0073%/1% RH (over a range of from 20-70% RH).

WATER ELONGATION (70F)

1/2 hour	1 hour
.51%	.59%

M. I. T. FOLDING ENDURANCE - 40 double folds.

STIFFNESS - 4 Taber stiffness units.

MODULUS OF ELASTICITY - 425,000 p.s.i.

TENSILE STRENGTH - 13,000 p.s.i.

YIELD STRENGTH - 11,000 p.s.i.

ELONGATION AT BREAK POINT - 30%

TOTAL THICKNESS - 149.5 microns or .0059 inch.

PROCESSING

CHEMICALS

Anscochrome still films are designed for processing ⁱⁿ Anscochrome 80F Chemistry by your dealer, local commercial laboratories or the Ansco Color Laboratory, Building 6, Binghamton, New York. All the chemicals necessary for processing Anscochrome D/200 are available in the form of packaged developing outfits in 1 gallon and 3-1/2 gallon sizes. Chemicals for individual solutions and replenishers are also available separately. For home processing, a specially formulated 16 oz. developing outfit, ideally suited for use with the Anscomatic developing tank, is available.

EQUIPMENT

Ideally, for production scale operations fifteen tanks should be provided. Ten of these will be used for processing solutions and the remaining five for washes.

PROCEDURE

Using the Anscochrome 80F processing chemistry, it is essential that solution temperatures be controlled in order that reproducible results will be obtained. Maximum allowable variations are $\pm 1/2^{\circ}\text{F}$ for the First and Color Developers, $\pm 2^{\circ}\text{F}$ for the other solutions, and $+0^{\circ} - 5^{\circ}\text{F}$ for the wash water. Be sure to consult the instructions packaged with the Anscochrome 80F Film Developing Outfits for full information.

Standard ASA hand agitation (ASA PH4.1 1960) produces satisfactory results. Vane or gas burst agitation can be adjusted to give results equal to standard ASA hand agitation.

Certain techniques which have been used successfully in black-and-white processing cannot improve, and may even harm, the quality of your Anscochrome

D/200 film during processing.

The following recommendations should be carefully noted before processing is begun:

1. Do not presoak Anscochrome film in water before processing.
2. Do not use water rinses between the two developers and short-stop hardeners.
3. Do not extend the washes beyond the recommended times.
4. Do not use wash water temperatures higher than 80°F.
5. Whenever possible, use regular tap water for washing. Optimum physical hardness of the emulsion is obtained when the wash water contains between 150 and 300 P. P. M. (parts per million) of hardness salts.
6. Do not keep shortstop-hardener solutions longer than 14 days or use them beyond the recommended number of Anscochrome rolls.

PROCESSING CHART

Solution Temperatures 80°F Wash Temperatures 75-80°F			
	Formula	Step	Minutes
TOTAL DARKNESS	504-A	First Developer	8½
	907-A	Shortstop-Hardener	2
LIGHTS ON		Wash	2½
		Second Exposure*	
	611	Color Developer	10
	907-A	Shortstop-Hardener	2
		Wash	5
	718-B	Bleach	3½
		Wash	2½
	806-A	Fixer	2½
		Wash	4
	955	Stabilizing Bath	½
		Wash	½
	954-B	Anti-Spot Rinse	½
		Dry	

*Second Exposure—Fifteen (15) seconds, each side, 4-6" from fluorescent lamp.

If it is necessary to use a tungsten lamp, the distance between the lamp and the film should be increased to 12" to avoid heat damage, and the film should be exposed for 30 seconds on each side. Use a 100 watt bulb for the exposure.

DRYING

Low Relative Humidity (25-35%) and clean air at a temperature of not over 100F are recommended for drying Anscochrome films. Ideally, a separate room or cabinet having controlled temperature, humidity, and air circulation, should be provided. High temperatures and infrared lamps are not recommended.

FORCED PROCESSING

Processing of Anscochrome D/200 to obtain other than the published film speed is not recommended. Changes in developer times result in detrimental changes in color balance and maximum density.

STORAGE

Optimum Storage - 50F or below.

An ordinary household refrigerator may be used for storing unbroken, factory-sealed packages. Film should be allowed to attain room temperature before opening. It requires approximately four hours for a roll of film to reach room temperature after removal from storage at zero F degrees. Processed film should be stored in a cool dry place.

The photographic material described followed the outline of important characteristics of a photographic material, previously mentioned. Other manufacturer's data perhaps not as complete in its specifications of sensitometric and physical characteristics are just as vague in describing color quality and if mentioned the ~~effects~~ ^{image degradation} of successive generations. Due to this, except in a few

cases where equipment and material investigation have been done, all of the equipment and photographic material information will have to be supplied by the manufacturer. The alternative, and the better choice, would be a program conducted on an evaluation of the photographic material and equipment of interest. In some areas, for example, this has already been done with a comparison of aerial films in terms of resolution and color quality objectively measured. In addition several equipment evaluations have also been performed in terms of repeatability, operating characteristics, and product uniformity. Manufacturers' data once again is vague in the areas of repeatability, product uniformity, and probably biased in its description of operating characteristics. The following example is a typical extract from the manufacturer's description of a piece of equipment.

~~MATERIAL~~

EASEL-MATIC TABLE TOP ROLL EASEL

Byers Easel-Matic table top roll easel provides a format for projection printing onto continuous roll paper which is valuable in continuous roll processing. The Easel-Matic, manufactured by Byers of Portland, Oregon is produced in two models. The 8-inch model Easel-Matic (with masks for 8 x 17 and 8 x 10) will accept a paper width up to 8 inches while the 11-inch model Easel-Matic (with masks for 11 x 24 and 11 x 14) will accept a paper width up to 11 inches.

The Easel-Matic requires electrical power of one ampere at 115 volts ac to operate the motorized paper advance.

When in operation the focus plate rides on the paper automatically traveling with it. When the focus plate reaches the right edge of the mask it triggers a microswitch, actuating the brake and cutting the motor. The focus plate now covers the paper ready for the next print to be composed. The brake (de-energized when holding) keeps the paper taut between take-up and supply rolls which is important in borderless printing.

The easel will handle color or B/W down to 3-1/2 inches and lengths up to 1000 feet of single weight paper. Both the supply and take-up spool are contained in one cabinet.

The output of the Easel-Matic is primarily dependent upon the operator and exposure time. Being able to operate on an existing bench makes it unnecessary to remount enlarger.

The time required for changeover for both border and bor-

derless is approximately thirty seconds in the dark. If both border and borderless masks are desired they must be specified at an additional charge.

Price:

Either border or borderless:

8-inch model Easel-Matic (with masks for 8 x 17 and 8 x 10).

\$1795.00 F.O.B. Portland, Oregon.

11-inch model Easel-Matic (with masks for 11 x 24 and 11 x 14).

\$1895.00 F.O.B. Portland, Oregon.

Shipping weight 100 lb.

Add \$25. for Easel-Matic equipped for both border and borderless.

There is noticeably missing, as is often the case, in the above example, information concerning repeatability and product uniformity although uniformity may not be as applicable to this example but for a printer or processor would be.

SECTION II

The program to date has been concerned with the collection, organization, and cataloging of immediately available information on color materials, processes, and equipment. This has included products from still, aerial, and the motion picture areas. From Section I two outlines were presented concerning photographic materials and photographic laboratory equipment. A decision has to be made to determine what areas are of major interest and what photographic materials and equipment are of primary concern. A listing of types of photographic equipment has already been provided. The following is a listing of photographic materials of possible interest.

~~Following is a partial listing of materials to be included under color materials.~~

I. Negative

A. Camera Films

1. Professional Still

- a. Kodacolor - X
- b. Ektacolor Type s and 1
- c. Ektacolor Professional Type s and 1.
- d. Agfacolor Type 17M and CN17S
- e. Ilfacolor
- f. Separation Negatives

2. Aerial

- a. Aero-Neg

(1) SO-151 (2448)

g. Movie Reproduction

- (1) Gevacolor Type 9.0
- (2) Ansco Dup
 - (a) 2470
 - (b) 5470
- (3) Eastman Kodak
 - (a) Internegative
 - (b) Reversal Print Film
 - (c) Ektachrome Reversal Print Film

B. Reproduction Material Still and Aerial

1. Positive Prints

- a. Ektachrome Type R and Improved Type R
- b. Ansco Printon
- c. Ciba Cilchrome

2. Transparency Duplicate

- a. Ansco Type 647 and 547
- b. SO-271
- c. 5388 (SO-118)
- d. Ektacolor Slide Film

3. Internegative - Kodak

- (2) 8442
- (3) 8443
- (4) SO-121
- (5) Anscochrome D-200

b. Standard Negative

- (1) Ektacolor Aerial SO-276
- (2) Agfacolor ACrial CN-17

3. Motion Picture

- a. Gevacolor Type 6.53
- b. Eastman Type 5251
- c. Eastman Separation ~~6~~ film Type 5235

B. Reproduction Materials

1. Reflection Prints

- a. Ektacolor 20
- b. Ektacolor Professional
- c. Ilford Ilfacolor
- d. Pwvella Starlight
- e. Gevacolor Paper
- f. Ferraniacolor
- g. 3M Electcolor
- h. Dye Transfer Print
- i. Agfacolor
- j. FR Paper

2. Transparency

- a. Ektacolor Print Film
- b. Agfacolor Print Film
- c. Eastman Kodak Dupe Intermediate

II. Positive

A. Camera Films

1. Professional

- a. Ektachrome, Daylight and Type B
- b. High Speed Ektachrome Daylight and Type B
- c. Ektachrome - X
- d. Kodachrome II Daylight
- e. Kodachrome II Professional A
- f. Kodachrome - X
- g. Agfachrome
 - (1) CT-18
 - (2) CK-20
 - (3) CTP-120 Daylight - Professional
 - (4) CKP120 Tung. - Professional
- h. Ilfachrome 32
- i. Perutz - Peruchrome
- j. Anschrome
 - (1) Daylight Type
 - (2) T-100 Tungsten
 - (3) 200 Daylight
 - (4) Ultra Super 500
- k. Dynachrome

2. Aerial

- a. 2448 (SO-151), SO-368 Thin Base
- b. SO-155
- c. SO-397
- d. 8442

- e. 8443
- f. SO-180
- g. SO-282
- h. Anscochrome D-200
- i. SO-121

3. Motion Picture

a. Agfacolor

- (1) CT-13S
- (2) CK-17S

b. Ansco

- (1) D-50
- (2) D-100
- (3) T-100
- (4) D-200
- (5) Moviechrome - 8
- (6) Moviechrome - 8 Type A

c. Gevacolor Positive Type 9.53

d. Ilfochrome 25

e. Dynachrome

f. Eastman Kodak

- (1) Kodachrome II
- (2) Kodachrome II, Type A
- (3) Ektachrome Commercial Type 7255
- (4) Ektachrome EF Type 5241 and 7241
- (5) Ektachrome EF Type B5242 and 7242
- (6) Ektachrome MS Type 5256 and 7256